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THE EPA HAZARDOUS WASTE ENGINEERING RESEARCH LABORATORY'S RESEARCH PROGRAM IN SUPPORT OF SUPERFUND

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In anticipation of the passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund), the Office of Research and Development of the USEPA began a program in 1980 to support the Agency's activities concerned with uncontrolled hazardous waste sites. In the area of environmental engineering and technology, the Agency looked to the ongoing and established programs in land disposal of hazardous waste and hazardous spill cleanup. Thus a research program was established to develop and evaluate removal and remedial cleanup technology. This program is being conducted by the Hazardous Waste Engineering Research Laboratory in Cincinnati, Ohio.

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ABSTRACT

In anticipation of the passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund), the Office of Research and Development of the USEPA began a program in 1980 to support the Agency's activities concerned with uncontrolled hazardous waste sites. In the area of environmental engineering and technology, the Agency looked to the ongoing and established programs in land disposal of hazardous waste and hazardous spill cleanup. Thus a research program was established to develop and evaluate removal and remedial cleanup technology. This program is being conducted by the Hazardous Waste Engineering Research Laboratory in Cincinnati, Ohio.

The Superfund program has been organized into four research areas: (1) containment technologies for remedial actions; (2) on-site cleanup equipment; (3) in-situ treatment of hazardous waste/contaminated soils; and (4) personnel protection.

The containment technologies area includes projects dealing with barriers to minimize surface water infiltration, limit or divert groundwater contact with waste, and control leachate migration; waste storage, either temporary or long-term; waste and leachate treatment; remedial action technical evaluations and modeling; and post closure evaluations.

An analysis of in-situ methods for cleaning contaminated soils has identified three approaches to the problem. The first approach is the extraction of contaminants from the soil with ultimate treatment of the extracted material in conventional wastewater treatment plants either on or off site. Methods such as surfactant washing and freezing would be included in this category. A second approach is the immobilization of the contamination within the soil column to eliminate its transport. Included in this approach would be methods such as grouting, pH adjustment, and thermal fusion. The third approach would be the degradation/detoxification of the contaminants in place, for example, the application of microbes or chemicals to the soil that change the contaminants to a nontoxic or less toxic form.

Paper presented at the International Conference on New Frontiers for Hazardous Waste Management, Pittsburgh, PA, September 1985.

Crosscutting these three approaches is the need for methods to deliver the chemicals, grouts, microbes, etc., to the soil and methods to recover material where applicable.

On-site separation, concentration, and detoxification technologies are an alternative to containment and off-site disposal. On-site technologies being evaluated include a mobile incinerator, soils washer, and carbon regenerator.

The objectives under the personnel protection area are: (1) to develop and evaluate chemical protective clothing and equipment; and (2) to develop and evaluate procedures that will result in reduced chemical exposures, safer working conditions, and more economical and efficient working conditions without a reduction in safety.

INTRODUCTION

In anticipation of the passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund), the Office of Research and Development of the USEPA began a program in 1980 to support the Agency's activities concerned with uncontrolled hazardous waste sites. In the area of environmental engineering and technology, the Agency looked to the ongoing and established programs in land disposal of hazardous waste and hazardous spill cleanup. Thus a research program was established to develop and evaluate removal and remedial cleanup technology. This program is being conducted by the Hazardous Waste Engineering Research Laboratory in Cincinnati, Ohio.

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CONTAINMENT TECHNOLOGIES

Introduction

Containment technologies are used for the isolation of specific contaminants and/or the reduction of liquid flow in and around a designated area. The first effort in this program was the compilation of available remedial action technologies which resulted in two handbooks: "Handbook for Remedial Action at Waste Disposal Sites - 1982,"[1] and "Handbook for Evaluating Remedial Action Technology Plans - 1983."[2] Based on these reviews, a containment research plan has been developed. In addition, the remedial action program has been involved in cooperative efforts with other countries, federal agencies, and industrial groups to meet the challenge of finding improved, cost-effective, and durable containment technologies for remedial actions at CERCLA sites. This interaction has proven to be very effective in minimizing program duplication and maximizing the potential positive impact within available resources. The program has been divided into four areas: Barriers, Waste Storage, Waste Treatment, and Remedial Action Technical Evaluations/Modeling.

Barriers

Barriers can be used to minimize surface water infiltration, limit or divert groundwater contact with the waste, and control leachate migration.

Within the existing program, containment technologies continue to be evaluated at three full-scale

operations, two of which are Superfund sites. The technologies being evaluated include bentonite slurry walls, flexible membrane liners as caps, and leachate treatment systems.

A pilot-scale demonstration on bottom sealing was conducted for the Office of Emergency and Remedial Response (OERR). It was shown that jet grouting has a potential for placing a bottom seal, but further development work is necessary. A handbook on leachate plume management techniques is scheduled for publication in early FY'86.

The following five types of barriers have been identified for further study:

° Walls are typically either slurry walls, grout curtains, or sheet piling cutoff walls. Some slurry walls have been used in combination with flexible membrane liners and cement-bentonite materials. Initial efforts have concentrated on the reactivity of the materials with organics and determining their net effectiveness in a real world environment. Future activity will be directed toward improved methods of determining effectiveness and compliance with pre-construction specifications and continuing the reactivity studies.

° Covers are usually an integral part of any remedial action. Minimizing surface infiltration typically consists of regrading, diverting surface water runoff, and preventing or eliminating infiltration. Well compacted clays and/or flexible membranes are in primary use. Efforts to date have concentrated on determining the effectiveness of their intended use. Future activity will look to improving system design, installation, and alternative materials.

° Active barriers emphasize the diversion of groundwater or leachate as compared to the passive approaches of installing either impermeable barriers or permeable treatment beds. Three applications are most common: pumping to lower a water table, pumping to contain a plume, and groundwater treatment systems. By and large, active barriers are very expensive to operate and maintain; nevertheless, they are the only option in some circumstances. Efforts to date have concentrated on the treatment aspects of counter pumping. Future activities will be directed to reducing O&M costs through the use of improved systems.

° Innovative technologies consist of those containment techniques that are new and/or novel to the user community involved in remedial actions at uncontrolled hazardous waste sites. There is no current activity in this area. Future work could involve new types of cutoff walls.

° Bottom sealing has not been a part of any known Superfund remedial actions; however, activities to date have included the demonstration of a bottom sealing technique with limited success. A lot was learned from this study and the potential for using a new slant drilling technique could be demonstrated in the future program.

Waste Storage

Storage, either short-term or for more extended periods of time, can serve as a temporary or long-term containment option.

Within the existing program, long-term storage in mines is being investigated for dioxin wastes, as well

as the fixation or containment methods that would need to be utilized as a part of the waste storage containment option.

The three major areas of activity under storage include the following:

° Mines have been investigated/evaluated for their potential technical suitability for hazardous waste storage. A research program on characterization and containment of hazardous wastes for mine disposal was completed in 1977 under the RCRA program. In 1983 a RCRA-funded study updated the 1977 report. The concept appears feasible from a technical standpoint. Political and social concerns are yet to be resolved and regulation developed by EPA.

° Above ground storage has been proposed by U.S. EPA Region VII as an option for dealing with the dioxin problem in Missouri. Currently there is no activity in the remedial action program area directed at above ground storage.

° Packaging of hazardous waste in drums is a very popular practice; however, it can lead to serious environmental problems when the drums deteriorate with time. A device that can spin-weld a polyethylene overpack around a drum containing hazardous waste was developed under the RCRA program and is now being field-tested under the containment program. Future activity in this area will depend in a large part on the acceptance of the storage concept.

Waste Treatment

The single, most important advantage of direct treatment methods is that it can result in removal/containment of pollution at the source. In most cases, treatment can be considered a long-term permanent solution. Many of the direct waste treatment methods are not fully developed and the applications and process reliability are not well documented. Extensive use of these techniques will require considerable pilot plant work. There is an absolute glut of information on waste treatment in general, but its applicability as a containment technology for uncontrolled hazardous waste sites remains to be sorted out.

Planned activity in the area of waste treatment includes the following:

° Stabilization/Fixation/Encapsulation

Waste solidification involves techniques designed to seal the wastes in a hard stable mass. Much of the information on solidification is of a proprietary nature. The application of these techniques to hazardous waste sites is going to be limited by the cost factors associated with excavation, analytical characterization, and process optimization. The majority of activity in this area is being funded under the RCRA program. Future activity in the containment technologies area would attempt to maximize the application of the existing information base to remedial actions.

° Leachate Control and Treatment

Leachate collection systems are applicable to control of surface seeps and seepage of leachate to groundwater. Groundwater contamination by leachates results from water percolating through the site as well as from lateral groundwater through the fill material. A significant data base on treatment techniques applicable to leachates already exists. Future activities would tailor this information to the on-scene coordinator and other

responsible parties such as the response teams and state officials.

° Permeable Treatment Walls

This technology has not been applied at any known Superfund sites. Current level of activity is attempting to optimize a test procedure that could be taken to a site and predict the potential for using local indigenous materials for leachate treatment utilizing the permeable treatment wall concept. Since the materials would become depleted with time, future activities will be directed to developing suitable methods for dealing with the concentrated waste by-products of the system.

Remedial Action Technical Evaluations

Technical evaluations are meant to increase the level of understanding of complex containment technologies, provide standards of comparison when deciding which techniques are most applicable to a specific site, and to quantify and document the extent and type of technologies being used on a nationwide basis.

Technical evaluations are divided into the following two areas of activity:

° Case studies analyze response actions from the perspective of technology, cost, planning, and management. Two studies have already been completed--one in 1982[3] and one in 1984.[4] A total of 33 case studies has been completed. At the request of OERR, a third study was initiated in 1984. It is expected that future activity will continue in this area.

° Full-scale evaluations and modeling are necessary to quantify the performance, reliability, long-term effectiveness, and costs of complex containment systems where barriers, waste storage, and waste treatment might all be included as part of the overall remedial action. Several full-scale evaluations at Superfund sites are underway and anticipated to be continued and expanded to additional sites. Modeling technology has been developed for evaluation of remedial action alternatives and will be updated to reflect improved performance, reliability, and cost information from full-scale studies, case studies, and other research areas.

IN-SITU TREATMENT

Introduction

To date, remedial actions for contaminated soils have usually been removal and burial in a secure landfill, or isolation on-site, e.g., covering with clean soil. Both of these methods have shortcomings. Removal and burial has transportation-related problems, high cost, and long-term liabilities, i.e., the landfill of today may be the Superfund site of tomorrow. Isolation techniques are frequently only partially effective and the waste is not destroyed. Alternative methods are needed to solve this national problem.

In-situ technologies appear to have significant merit for soil cleanup. In-situ methods are defined herein, as those methods in which the treatment is applied without removal of the material to be treated, irrespective of whether the waste is excavated as a total mass or removed in increments.

This definition does not exempt those processes when the soil is manipulated in-place, such as disking and plowing. In-situ processes thus eliminate transportation, the

creation of a new hazardous waste site, and multiple handling and processing of the soil. Besides the technical problems involved with removing the contaminated soil from the site, it is often politically and socially unacceptable because of the "not in my backyard" disposal syndrome.

Proven cost-effective, in-situ methods would have wide application across the nation. In addition to the utilization of the technique by state and Federal Superfund programs, it would have application by industries who choose to clean up their own sites.

An analysis of in-situ methods for cleaning contaminated soils has identified three approaches to the problem. The first approach is the extraction of contaminants from the soil with ultimate treatment of the extracted material in conventional wastewater treatment plants either on or off site. Methods such as surfactant washing and freezing would fall into this category. A second approach is the immobilization of the contamination within the soil column and thus eliminate its transport. Included in this approach would be methods such as grouting, pH adjustment, and thermal fusion. The third approach would be the degradation/detoxification of the contaminants in place, for example, the application of microbes or chemicals to the soil that chemically change the contaminants to a nontoxic or less toxic form.

Crosscutting these three approaches is the need for methods to deliver the chemicals, grouts, microbes, etc., to the soil and methods to recover material where applicable.

The approach taken in this research plan has been to define the problem options through state-of-the-art reviews. For those options that show the best potential, development and field validation studies have been initiated. Final validation occurs with demonstration at hazardous waste sites of opportunity.

Extraction Processes

Extraction processes are defined as processes in which the pollutant is removed from the soil matrix and then treated in a separate facility either located on-site or off-site. The ultimate treatment of the extracted material is not considered here except in connection with recovery of extraction fluids. Five extraction concepts have been identified for further study:

- Flushing the soil with water, water plus surfactant, pH-adjusted water, or with other solvents. Initial efforts are underway with water and water/surfactants. In out-years, these will be field-evaluated and other solvents will be studied.

- Freezing has been used to remove contaminants from liquids. The freezing process is being evaluated as a means of removing pollutants from saturated soils. If preliminary studies look promising, further development will occur.

- Electrokinetic techniques have been utilized to dewater saturated clays and slimes. There is also a potential that various ions can be removed due to the potential established at the electrodes. A pilot evaluation was initiated in FY'85. If successful, full-scale evaluation will be made if funds become available from other sources.

- Vegetation has been noted to extract certain pollutants from the soil. This process may have

application to remove low levels of pollutants from the soil, e.g., as a polishing step in a soil cleanup. Laboratory-scale studies will be conducted in the out-years.

° The application of heat to a soil may result in the volatilization of some pollutants and thus their removal from the soil matrix. (A feasibility study will be conducted on this process in FY'88.)

Immobilization Processes

Immobilization processes include a wide range of technologies to reduce the rate of release of contaminants from the soil so that resultant concentrations of exposure are held within acceptable limits. The primary immobilization mechanisms are solidification, sorption, ion exchange, and precipitation. Immobilization of dust to prevent fugitive emissions is under investigation. Seven immobilization concepts have been identified for further study.

° Grouting with either polymer material or crystalline matrix forming materials produced a material that has reduced surface area subject to leaching. Cement grouts are an example of such a process. Studies are underway on grout-pollutant interactions and grouting techniques. Field validation will be conducted in out-years.

° Thermoplastic is the process of utilizing asphalt to reduce the surface area subject to leaching. Initial studies of this process are limited to treating dioxin-contaminated soils.

° Precipitation (reduce Ksp) can immobilize metals. The addition of sulfides, carbonates, phosphates, and hydroxides can immobilize metals by precipitation of a highly insoluble compound. These processes are at the conceptual/laboratory stage and further work is planned.

° Thermal fusion (vitrification) of inorganic material can be accomplished by the application of sufficient heat to cause vitrification of the soil and pollutant. In addition to treating the inorganic pollutants, organic materials are volatilized and extracted or destroyed. The Department of Energy has developed this process for transuranic waste and is now field testing the concept. The process will be evaluated for hazardous waste sites.

° Sorption of organics and heavy metals can be used to bind the pollutant into a sorbent/soil complex. For heavy metals, activated carbon or tetran can be used as a sorbent. Organic carbon, such as organic matter, can be used as an organic sorbent. This technology is at the laboratory/pilot evaluation stage. It will be further studied in the out-years.

° Ion exchange materials can be used to absorb ions. Certain clays, synthetic resins, and zeolites have the capacity to release ions of one type and to preferentially absorb ions of another type. This technology is at the laboratory/pilot evaluation stage. It will be further evaluated in the out-years.

° Fugitive dust control methods are being evaluated in field pilot studies and a handbook is being prepared. Demonstrations at sites-of-opportunity are planned.

Degradation/Detoxification Processes

Degradation/detoxification processes include a range of technologies that through chemical, biological, or photo processes, transform soil contaminants into less toxic or less mobile products. A wide range of techniques hold promise.

- Chemical degradation can be accomplished by oxidation, reduction, and polymerization reactions. Introduction of chemical oxidants (ozone or hydrogen peroxide), reducing agents (catalyzed metal powders), or polymerization agents (iron and sulfates) are conceptual processes for chemical degradation. Further evaluation of these processes will be made.

- Biodegradation refers to the breakdown of organic compounds in soils by the action of micro-organisms such as bacteria, actinomycetes, and fungi. Treatment generally consists of optimizing conditions of pH, temperature, soil moisture, soil oxygen, and nutrient concentrations to stimulate the growth of micro-organisms that will feed on particular contaminants that are present. Optimization studies are being conducted. Field evaluations will be conducted at pilot-scale.

- Photochemical reactions require the absorption of light energy, generally sunlight, to detoxify the soil contaminants. Since light does not penetrate very far into soils, photodegradation is limited to soil surfaces. Evaluations of this technique will be made. If found feasible, further development will occur.

Delivery and Recovery Methods

Crosscutting the extraction, immobilization, and degradation processes are methods to deliver chemicals, grouts, microbes, etc., into the soil system. A major limitation to almost all in-situ processes is the delivery system. In addition, the extraction systems require methods to recover the extracted material. Some other systems also require recovery systems to recover agents applied to soil in order to maximize agent usage and cost. A mobile in-situ containment/treatment system has been developed and is undergoing evaluation. Further evaluations of delivery and extraction methods will be made.

ON-SITE CLEANUP

Introduction

Response to an episodic hazardous material incident or a situation at an uncontrolled site typically involves efforts to stabilize the situation, followed by efforts to remove contaminants within practical reach by current technologies. On-site treatment of contaminated soils is a particularly under-developed technology area. Primitive contaminated soil "cleanups," involving "dump trucks and take-it-somewhere-else" philosophies, simply transfer the contaminants from the uncontrolled site to landfills--perhaps creating future waste disposal site problems elsewhere. For treatment of confined waters, such as ponds and lagoons, some advanced contaminant collection and removal technologies are available, though not consistently used. Treatment of water contaminated with highly volatile organics is another "gray" area, where sometimes-used air sparging releases contaminants to the atmosphere and rightly causes public concern. What is needed, and what can be achieved under this research plan, is a systematic and thorough cost-examination and documentation of

a wide variety of effective, on-site separation, concentration, and detoxification technologies.

On-Site Incineration

Incineration is an ultimate disposal technology that is capable of destruction and detoxification of liquid and solid organic hazardous materials that have contaminated soils, or are in concentrated form in drums or tanks, and debris. The EPA-developed mobile incineration system has undergone a trial burn on RCRA liquids (CCl_4 and orthodichlorobenzene) and TSCA liquids (PCB's) with excellent destruction and removal efficiency. The incinerator completed a trial burn and field test on dioxin-contaminated soils and liquids at a waste site in Missouri in the summer of 1985.

Evaluation of on-site incineration technology includes these major projects:

- Mobile incineration system
- Transportable incineration system
- Commercially-developed systems

An evaluation of transportable incineration systems for destruction of toxic organic wastes at Superfund sites in the United States is planned. A preliminary feasibility study on transportable incineration systems has been completed. A transportable incinerator would have 5-10 times the capacity of the mobile incineration system, would be set up for a longer period, 3-5 years, and would be used as a dedicated system to dispose of the incinerable wastes from a cluster of Superfund sites. All component parts for the transportable incinerator are commercially available.

On-Site Treatment/Control Technologies

The evaluation of EPA-developed on-site treatment/control technologies includes testing of two major prototypes currently available:

- Mobile soils washing system for treating excavated soils
- Mobile carbon regenerator for reactivating spent carbon used to process contaminated liquids

Commercially Developed on-Site Treatment Technologies

The program area of evaluation of commercially developed on-site treatment technologies is a cooperative research effort between EPA and the commercial sector. It will provide the Agency with an opportunity to have private industry cost-share in the demonstration and evaluation of state-of-the-art equipment. It includes two major project groups:

- Pilot-scale evaluations
- Full-scale evaluations

Evaluation of commercially developed on-site treatment technologies is a new program and a new approach. Significant progress is now being made in the development of hazardous waste treatment technologies and equipment by the private sector. Proponents of the new technologies may have unique solutions to particular on-site cleanup problems but need objective evaluation to support their claims. Thus, a program has been initiated to identify and evaluate a large number of commercially available technologies in a competitive, organized, and systematic manner. This approach will rely upon evaluations that are cost-shared with the developing organizations. Many companies have shown a willingness to loan equipment to EPA for testing or otherwise have offered a substantial financial commitment toward testing.

EPA's involvement will be limited to the arrangement of an objective evaluation through such activities as experiment design, quality control/quality assurance, and report preparation and dissemination. This new approach offers the opportunity to stretch Federal funding over a wider variety of technologies, thus having a greater influence in providing information to EPA Program Offices and stimulating commercial development. This program was started with two groups of projects: evaluation of pilot-scale technology at an appropriate testing facility, and evaluation of full-sale technology at waste sites and under controlled conditions.

PERSONNEL PROTECTION

Introduction

The Personnel Protection Research Program will provide data, information, and technology to enhance the Agency's capability to perform its mandated roles that require either (1) regulation of pesticides and toxic substance handling and use; or (2) operation by EPA or contractor personnel in hazardous atmospheres at chemical spills and hazardous waste sites. In order to achieve the data, information, and technology outputs of the program, five sub-objectives will be pursued:

- To develop and evaluate chemical protective clothing and equipment.
- To develop and evaluate procedures that will result in reduced chemical exposures, safer working conditions, and more economical and efficient working conditions without a reduction in safety.
- To develop and verify methods to predict the effectiveness of chemical protective clothing.
- To ensure that the data produced in the personnel protection research program is of acceptable precision and accuracy such that the uniformity of data collection and analysis procedures will be maximized and duplication of QA/QC will be minimized.
- To ensure that EPA Program Office personnel protection research needs are considered during the development of research plans; to utilize existing information, facilities, and expertise to the maximum extent by cooperating with other agencies and organizations; and to promote maximum utilization of research outputs.

Chemical Protective Clothing and Equipment to Support EPA and Contractor Personnel at Superfund Sites

EPA field personnel activities at chemical waste and spill sites have shown that the safety and operational effectiveness of commercially available protective clothing, equipment, and procedures are not acceptable for some EPA requirements. Also, testing and evaluation of the safety and efficiency of new protective clothing, equipment, and procedures are not currently conducted in an efficient manner, and the test results are not distributed by EPA organizations (e.g., the Environmental Response Team and regional spill and site response organizations) that could benefit from the information.

Research in support of OERR requires the development and/or evaluation of various items of protective clothing, equipment, and procedures. It is generally accepted that no item of protective clothing or equipment is "appropriate" for all chemical exposure situations. "Appropriate," as used here, means that the protective item (1) prevents harmful exposure to

chemicals; (2) permits the wearer to perform work without undue stress or impairment; and (3) can be afforded by the user community. Even though complete protection will probably not be accomplished, improvements in chemical resistance, comfort, and cost will yield significant benefits to the user community. The development of a 2.5-hour chemical protective ensemble will be completed in FY'85 and its applicability to EPA operational uses will be tested by NIOSH, by EPA users, and by other testing organizations. The permeation resistance of polymer gloves and outergarment materials to selected highly toxic chemicals and common solvents will be evaluated both through inhouse and contract activities. Newly developed safety clothing technology that appears to offer significant benefits will also be evaluated and tested according to OERR and Regional needs, and state-of-the-art advances. New clothing materials, personal cooling devices, respiratory protection equipment, totally encapsulating ensembles, communications equipment, and personal hazard detectors are some of the items that will require periodic assessment. To aid in the selection of appropriate protective clothing in the field when unknowns or mixtures are involved, field methods for choosing and checking protective clothing will be developed and evaluated. To promote the economical use and re-use of chemical protective clothing and other equipment, contamination avoidance procedures and decontamination agents and procedures will be evaluated and developed as required.

TECHNOLOGY TRANSFER

In order to transfer the state-of-the-art being evaluated within this program to the user community, a series of Superfund remedial/removal criteria handbooks has been prepared. Following is a listing of the twenty-five handbooks that have been or will be published through FY'86.

1. Guidance Manual for Minimizing Pollutions from Waste Disposal Sites, EPA 600/2-78-142

2. Compatibility of Grouts with Hazardous Wastes, EPA 600/2-84-015

3. Review of In-Place Treatment Techniques for Contaminated Surface Soils,
   --Volume 1--Technical Evaluation, EPA 540/2-84-003a
   --Volume 2--Background Information for In-Situ Treatment, EPA 540/2-84-003b

4. Handbook for Remedial Action at Waste Disposal Sites, EPA 625/6-82-006

5. Handbook for Evaluating Remedial Action Technology Plans, EPA 600/2-83-076

6. Slurry Trench Construction for Pollution Migration Control, EPA 540/2-84-001

7. Remedial Response at Hazardous Waste Sites,
   --Summary Report, EPA 540/2-84-002a
   --Case Studies, EPA 540/2-84-002b

8. Design and Development of a Hazardous Waste Reactivity Testing Protocol, EPA 600/2-84-057

9. Leachate Plume Management, (to be published in FY'86)

10. Modeling Remedial Actions at Uncontrolled Hazardous Waste Sites, EPA 540/2-85-001

11. Costs of Remedial Actions at Uncontrolled Hazardous Waste Sites: Worker Health and Safety Considerations, (to be published in FY'85)

12. Guide for Decontaminating Buildings, Structures and Equipment at Superfund Sites, EPA 600/2-85-028

13. Evaluation of Systems to Accelerate the Stabilization of Waste Piles and Deposits, (to be published in FY'85)

14. Covers for Uncontrolled Hazardous Waste Sites, (to be published in FY'85)

15. Stabilization/Solidification Alternatives for Remedial Action at Uncontrolled Waste Sites, (to be published in FY'85)

16. Fugitive Dust Control at Hazardous Waste Sites, (to be published in FY'85)

17. Field Manual for Plunging Water Jet Use in Oil Spill Cleanup, EPA 600/2-84-045

18. Guidance Manual on Overtopping Control Techniques for Hazardous Waste Impoundments, (to be published in FY'85)

19. A Guidance Manual for the Selection and Use of Sorbents for Liquid Hazardous Substance Releases, (to be published in FY'85)

20. Drum Handling Practices at Hazardous Waste Sites, (to be published in FY'85)

21. Manual of Practice for Marine Safety Officers and On-Scene Coordinators Involved in Chemically- and/or Biologically-Contaminated Underwater Operations, (to be published in FY'86)

22. Manual for Preventing Spills of Hazardous Substances at Fixed Facilities, (to be published in FY'86)

23. Reference Manual of Countermeasures for Hazardous Substance Releases, (to be published in FY'86)

24. Environmental Emergency Control Handbook for Hazardous Substances, (to be published in FY'86)

25. Flammable Hazardous Substances Emergency Response Handbook: Control and Safety Procedures, (to be published in FY'86)

Ordering information for published reports is available from the USEPA, Center for Environmental Research Information, Cincinnati, OH 45268, (513) 569-7562 or (FTS) 684-7562.

References

1. Handbook: Remedial Action at Waste Disposal Sites, U.S. Environmental Protection Agency, EPA 625/6-82-006, Cincinnati, Ohio, 1982.

2. Handbook for Evaluating Remedial Action Technology Plans, U.S. Environmental Protection Agency, EPA 600/2-83-076, Cincinnati, Ohio, 1983.

3. Survey of Ongoing and Completed Remedial Action Projects, U.S. Environmental Protection Agency, EPA 600/S2-81-264, Cincinnati, Ohio, 1982.

4. Remedial Responses at Hazardous Waste Sites, U.S. Environmental Protection Agency, EPA 540/2-84-002, Cincinnati, Ohio, 1984.